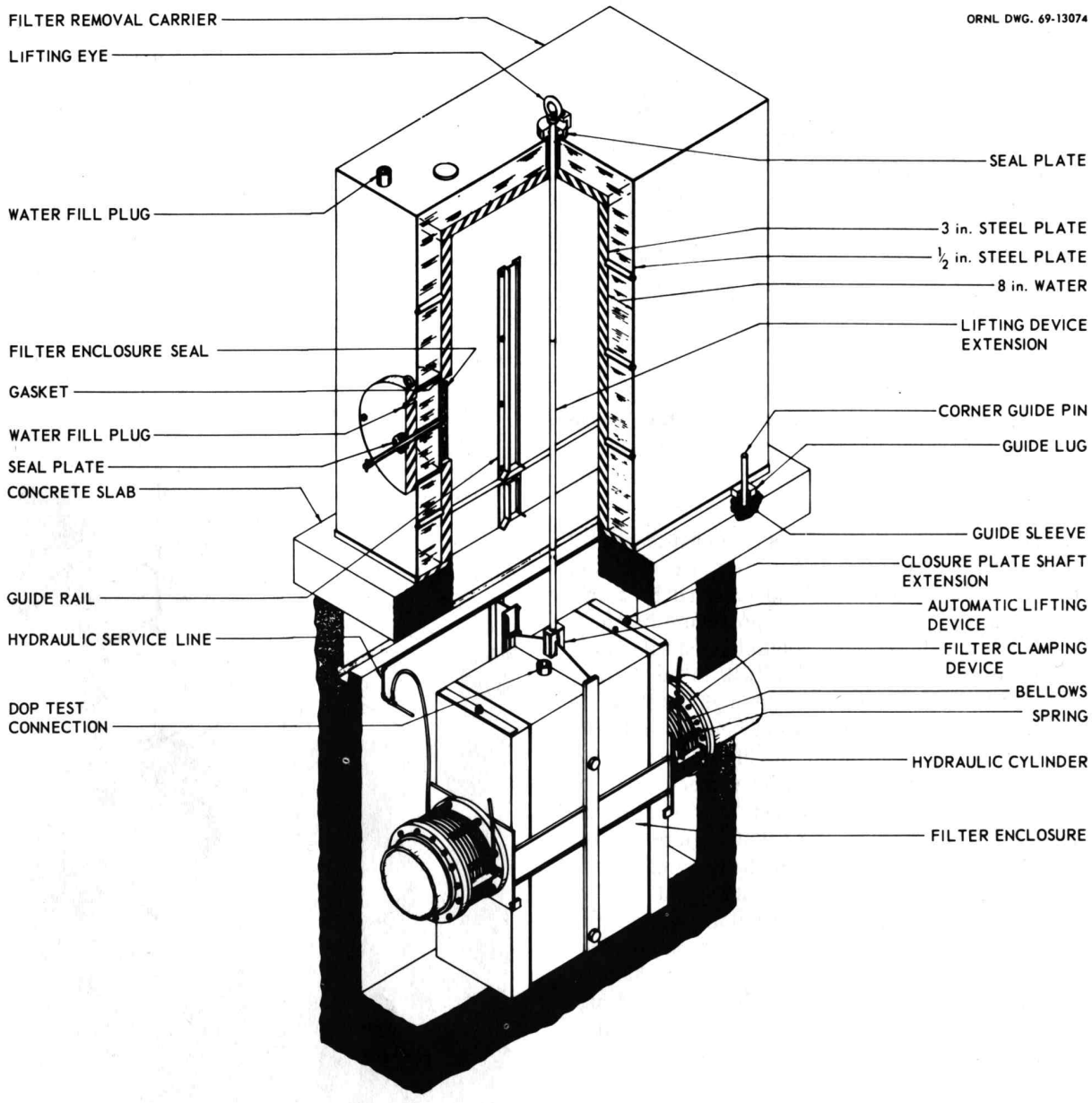

Figure 9.19 – TURF system (b)

9.3 SHIELDING

Ducts and housings may have to be shielded when gamma radiation "shine" exceeds the exposure limits specified by federal regulations.[42] Levels as high as 1,000 rem/hr may be expected at first-stage filters serving fuel reprocessing or radiochemical operations. Radiation must be reduced to tolerable levels if personnel are to occupy adjacent areas of the building even occasionally. Exhaust ducts and housings may have essentially the same hazard classification (see Section 2.2.1) as the contained space (e.g., glovebox, hot cell, building space, containment) they evacuate and should, therefore, be installed inside building spaces that provide some degree of secondary containment. When such building spaces are occupied, even infrequently, shielding must be provided if gamma radiation is, or could be, a problem. Requirements for designing shielding are described in several references, including:

- USAEC Report TID-25951, "Reactor Shielding for Nuclear Engineers," 1973 (available from National Technical Information Service, Springfield, VA)
- *Engineering Compendium of Radiation Shielding*, International Atomic Energy Agency, Springer-Verlag, New York, Berlin, vol. 1, "Shielding Fundamentals and Methods," 1968; vol. 2, "Materials," 1975; vol. 3, "Shield Design and Engineering," 1970.

Current information on shielding, including computer codes, can be obtained from ORNL's Radiation Shielding Information Center in Oak Ridge, Tennessee. Recommendations concerning the construction of concrete radiation shields can be found in ANSI N101.6.[20] Also see American Society of Mechanical Engineers (ASME) Boiler Code, Section III, Division 2, "Code for Concrete Reactor Vessels and Containments."[61]

9.4 NATURAL PHENOMENA

The ability of a system to survive and function during and/or following an earthquake or tornado must be taken into consideration in the design of ESF air cleaning systems. By definition, such systems "serve to control and limit the consequences of releases of energy and radioactivity in the event of occurrences, as described in ANS 51.1[34] and 52.1,"[35] [i.e., a design basis earthquake (DBE) or tornado (DBT)]. For additional information on this subject, see Chapter 2.

9.4.1 NATURAL PHENOMENA HAZARDS

The natural phenomena hazards (NPH) of interest at a site are earthquakes, winds/tornadoes, floods, and lightning. Earthquakes and winds/tornadoes can lead directly to a release of hazardous materials. Floods and lightning, on the other hand, usually are not directly responsible for the release of hazardous materials, but can initiate other events such as fires or spills that lead to releases. As such, these last two events should be discussed without specific details (unless deemed necessary for a specific site). DOE Order 420.1, "Facility Safety,"[1] and DOE G 420.1-2, "Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Nonnuclear Facilities,"[2] establishes the policy and requirements for NPH mitigation for DOE sites and facilities. DOE Order 420.1[1] utilizes a graded approach to provide NPH protection for occupant and public health and safety, the environment, property losses, and production and research objectives. This graded approach in design, evaluation, and construction of structures, systems, and components (SSCs) varies in conservatism and rigor, ranging from normal-use building to nuclear power plant structures. DOE Order 420.1[1] specifies that consistent NPH requirements in a graded approach are implemented by the use of target probabilistic performance goals. Performance goals are expressed as the annual probability of exceeding acceptable behavior limits beyond which an SSC may not perform its function or maintain structural integrity. Performance goals are targeted by specifying probabilistic NPH estimates and deterministic design and evaluation methods (including intentional and controlled conservatism). Performance Categories (PC) 1 through 4 are defined with target performance goals.

DOE Order 420.1[1] requires use of DOE-STD-1020-2002, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities"[3] to provide design and evaluation criteria for earthquakes, wind/tornadoes, and floods. This Order also requires this standard to be used as guidance in implementing the NPH mitigation requirements. DOE-STD-1020[3] specifies performance goals for PC 1 through PC 4, as well as relevant hazard probabilities, to establish the design basis loads. The goals of DOE-STD-1020[3] are to ensure that NPH evaluations are performed on a consistent basis, and that DOE facilities can withstand the effects of natural phenomena. Considerable new information and analysis/design methods have been developed since DOE-STD-1020[3] was issued. As of this writing, a "draft" version of proposed changes to DOE-STD-1020[3] has been issued for review and comments. This version will incorporate the seismic analysis/design requirements of the International Building Code (IBC)[4] The final revised version of this standard is expected to be available by Spring 2002. [Note: The IBC is a commercial code written without regard to nuclear requirements. For nuclear structural analysis, please reference ASME Boiler